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Coal Database for Cook Inlet and North Slope, Alaska

Data Series 599

U.S. Department of the Interior
U.S. Geological Survey

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By Gary D. Stricker, Brianne D. Spear, Jennifer M. Sprowl, John D. Dietrich, Michael I. McCauley, and Scott A. Kinney

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Mass	
ton, short (2,000 lb)	0.9072	metric ton

Horizontal coordinate information is referenced to North American Datum of 1927 (NAD 27).

Elevation, as used in this report, refers to distance above the vertical datum. Vertical coordinate information is referenced to mean sea level.

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Abstract

This database is a compilation of published and nonconfidential unpublished coal data from Alaska. Although coal occurs in isolated areas throughout Alaska, this study includes data only from the Cook Inlet and North Slope areas. The data include entries from and interpretations of oil and gas well logs, coal-core geophysical logs (such as density, gamma, and resistivity), seismic shot hole lithology descriptions, measured coal sections, and isolated coal outcrops.

Introduction

Coal occurs in isolated areas throughout Alaska (fig. 1). This report presents updated coal databases for the (1) Tertiary Kenai Group in the Southern Alaska-Cook Inlet province, referred to as Cook Inlet, and for the (2) Cretaceous Nanushuk and Cretaceous and Tertiary Prince Creek Formations and Tertiary Sagavanirktok Formation in the Northern Alaska-Slope coal province, referred to as North Slope. The purpose of the report is to provide dissemination and accessibility of the compiled coal data for the aforementioned coal-bearing areas in Alaska to U.S. Geological Survey customers and to the Department of Energy, National Energy Technology Laboratory, Pittsburgh, Penn., which funded this study through Interagency Agreement DE FE0000086.

This report does not focus on the classification of the coal resources or on the volume of coal that is estimated for Alaska. Table 1 shows previously published coal resource estimates for Alaska coal using the coal classification system of Wood and others (1983). These estimates are from work by Hopkins (1951), Wahrhaftig and Hickcox (1955), Barnes and Cobb (1959), Barnes (1967a), Renshaw (1983), McGee and Emmel (1986), Merritt and Belowich (1984), Merritt and Hawley (1986), Affolter and Stricker (1987), Sable and Stricker (1987), Stricker (1991), and Wahrhaftig and others (1994). These investigators applied a variety of resource categories. The classification categories for reporting coal resources as defined by Wood and others (1983) are based on degree of geologic assurance as measured by nearness to points of control and the relative quality and quantity of geologic data. The categories are (1) measured, (2) indicated, (3) inferred, and (4) hypothetical. The sum of the measured and indicated resources is termed "demonstrated resource." The sum of the measured, indicated, and inferred is termed "identified resource." The level of certainty for the existence of a quantity of resource is also based mainly on correlations of coal beds and enclosed rocks in relation to the thickness, overburden, rank, quality, and areal extent of the coal.

1. Measured coal resources have the highest degree of geologic assurance. Resource estimates are based partly on measurements from outcrops, trenches, drill holes, and mine workings. The area of measured coal resources is within 0.25-mi (0.4-km) radius of a point of thickness measurement.

2. Indicated coal resources have a moderate degree of geologic assurance. The area of indicated coal resources is between 0.25- and 0.75-mi (0.4- and 1.2-km) radii from a point of thickness measurement.

3. Inferred coal resources have a low degree of geologic assurance. The area of inferred coal resources is between 0.75- and 3-mi (1.2- and 4.8-km) radii from a point of thickness measurement. Estimates of coal thickness, extent, and quantity are based on inferred continuity, beyond measured and indicated resources, for which there is geologic evidence.

4. Hypothetical or undiscovered coal resources have the lowest degree of geologic assurance of these categories. Estimates of coal thickness, extent, and quantity are based on measurements and continuity of coal beyond parameters used in the inferred resources. The area of hypothetical coal resources is beyond a 3-mi (4.8-km) radius from a point of thickness measurement. Total identified resources shown in table 1 are 120,000 million short tons (109,000 million metric tons) for the North Slope and 2,900 to 12,000 million short tons (2,600 to 10,900 million metric tons) for the Cook Inlet; hypothetical resources for the same areas are 3,900,000 and 970,000 to 1,600,000 million short tons, respectively (3,500,000 and 880,000 to 1,450,000 million metric tons, respectively). Approximately 3 percent of the total coal resource for the North Slope is in the identified category and 0.30 to 0.75 percent of the total coal resource for the Cook Inlet is in the hypothetical category.

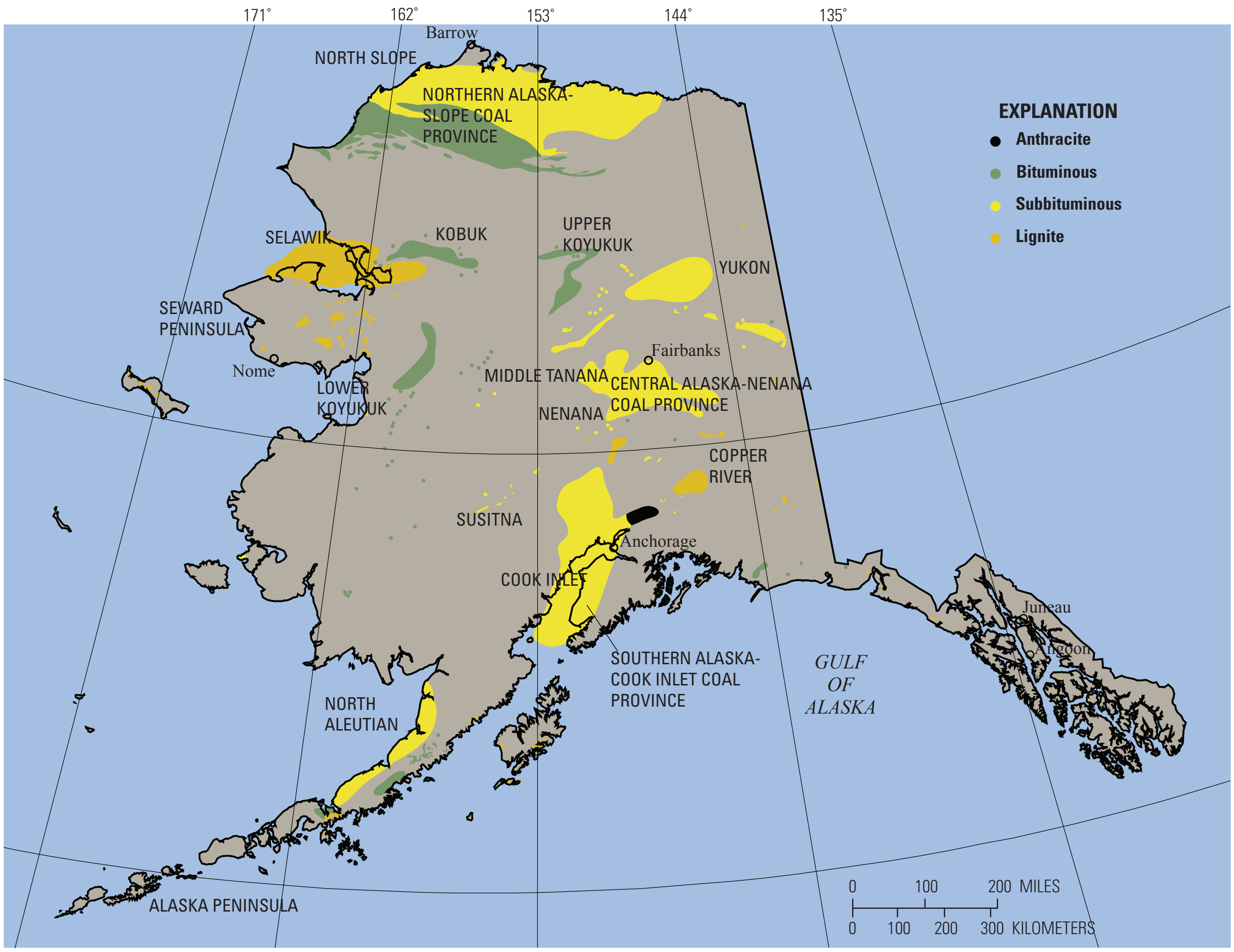

Figure 1. Locations of coal deposits in Alaska, color coded by coal rank, with emphasis on the Northern Alaska-Slope, Central Alaska-Nenana, and Southern Alaska-Cook Inlet coal provinces. Compiled and modified from Merritt and Hawley (1986); Barnes (1967a, 1967b); Magoon and others (1976); and Plafker (1987). Figure modified from Flores and others, 2004.

Table 1. Coal resource estimates for Alaska using the classification system of Wood and others (1983). From Flores and others (2004). [Resource estimates are in millions of short tons (multiply by 0.9072 to convert to metric tons)]

Coal province and coalfield, or age		Resource Classifications			
		Identified			Undiscovered
		Demonstrated		Inferred	Hypothetical
		Measured	Indicated		
Northern Alaska-Slope (North Slope)	Tertiary				670,000[a]
	Cretaceous	120,000[j]			3,200,000[a]
Total for Northern Alaska-Slope		120,000			3,900,000
Central Alaska-Nenana	Healy Creek	1,000[b]–1,360[c]			2,000[b]
	Lignite Creek	4,100[c]–4,900[b]			7,000[b]
	Jarvis Creek	13[e]–77[c]			175[b]
	Wood River	15[c]	45[c]	241[c]	
	Wood River	275[b]			350[b]
	Rex Creek		9.5[c]	113[c]	
	Rex Creek	70[b]			130[b]
	Tatlanika Creek		117[c]	153[c]	
	Tatlanika Creek	290[b]			400[b]
Total for Central Alaska-Nenana		6,400–7,700			10,000
Southern Alaska-Cook Inlet (Cook Inlet)	Matanuska	137[c]–200[g]			2,400[i]
	Susitna-Belugaa	2,400[c]–11,100[b]			34,800[b]
	Broad Pass	0.3[f]–64[c]			13[f]–500[b]
	Kenai (on shore)	318[c]–400[h]			34,000[e]–35,000[b]
	Kenai (off shore)				900,000[d]–1,500,000[b]
Total for Southern Alaska-Cook Inlet		2,900–12,000			970,000–1,600,000
Total coal resources for Provinces		129,000–140,000			4,900,000–5,500,000

Source of estimates: (a) Stricker (1991); (b) Merritt and Hawley (1986); (c) Barnes (1967a); (d) Affolter and Stricker (1987); (e) McGee and Emmel (1986); (f) Hopkins (1951); (g) Merritt and Belowich (1984); (h) Barnes and Cobb (1959); (i) Renshaw (1983); and (j) Barnes (1967b).

General Geology of Alaska

For a summary of the geology of Alaska, the reader is directed to the geologic map of Alaska by Beikman (1980), reports by Plafker and Berg (1994) and by Flores and others (2004), and to publications included on the reference lists in those publications.

North Slope Coal Province

The North Slope coal province (fig. 2) is the largest coal province in Alaska at approximately 32,000 mi^2 (82,880 km^2). This province also has the largest resource estimate of 3.9 trillion short tons (3.5 trillion metric tons) hypothetical (Stricker, 1991) and 120 billion short tons (109 billion metric tons) identified (Barnes, 1967a) in Cretaceous and Tertiary rocks. Known coal deposits in the North Slope coal province are from the Mississippian Kekiktuk Formation of the Endicott Group (Tailleur, 1965), the Cretaceous Nanushuk Formation, the Cretaceous and Tertiary Prince Creek Formation, and the Tertiary Sagavanirktok Formation (Mull and others, 2003) (fig. 3). Coal beds of the Kekiktuk Formation crop out at Cape Lisburne at the western edge of the North Slope (Tailleur, 1965; Barnes, 1967b; Conwell and Triplehorn, 1976) and as thin beds in the eastern Brooks Range (Sable, written commun., 1969 and referenced in Sable and Stricker, 1987, p. 208) and have not been assessed. These coals were also penetrated in several deep test wells that range in depth from 7,190 to 19,900 ft (2,190 to 6,070 m), in the National Petroleum Reserve in Alaska (NPRA) (Sable and Stricker, 1987). Outcrops of this coal are sparse and there are neither measured sections nor locality data for the coal occurrences. Also, because the coal is at depths greater than 7,190 ft (2,190 m; Sable and Stricker, 1987), which is deeper than the 6,000-ft (1,830 m) overburden cutoff depth of Wood and others (1983, p. 9), data from the Mississippian Kekiktuk Formation are not included in this report.

The Albian to Cenomanian Nanushuk Formation and the Campanian to Paleocene Prince Creek Formation, revised by Mull and others (2003), consist of sedimentary units shed eastward and northeastward from ancient highlands in the present Chukchi Basin and Brooks Range into the deep Colville Basin that lies between the Brooks Range and the Barrow arch. Peat deposits accumulated in coastal plains formed on river-dominated deltas (Ahlbrandt and others, 1979; Roehler and Stricker, 1979; Huffman and others, 1985). The coal-bearing Nanushuk Formation is as thick as 5,000 ft (1,500 m) in the western part of the North Slope province and thins to zero eastward. The contact between the Cretaceous and Tertiary rocks in the North Slope coal province is gradational (Molenaar, 1983; Molenaar and others, 1984) and difficult to define.

The Tertiary Sagavanirktok Formation represents the final filling of the Colville Basin in the eastern part of the North Slope coal province. Molenaar and others (1987) reported that the Sagavanirktok Formation is as thick as 7,500 ft (2,300 m). Roberts and others (1992) reported two coal zones in the Sagavanirktok Formation: a lower zone as much as 850 ft (260 m) thick with 12 coal beds and an upper zone as much as 360 ft (119 m) thick with 7 coal beds. The two coal zones are separated by as much as 295 ft (90 m) of interbedded sandstone and mudstone.

Cook Inlet Coal Province

The Cook Inlet coal province, the second largest coal province in Alaska, includes an area of approximately 22,200 mi^2 (57,500 km^2), about half of which lies beneath the waters of Cook Inlet (fig. 4). Most of the Tertiary coal-bearing rocks in the province are the Kenai Group (Calderwood and Fackler, 1972). The Kenai Group consists of the following time-transgressive units—from oldest to youngest—the Hemlock Conglomerate and Tyonek, Beluga, and Sterling Formations (fig. 5). This thick Tertiary coal-bearing section (Oligocene to Pliocene) filled a deep trough in the arc-trench gap between the Aleutian volcanic arc and the Aleutian Trench (Fisher and Magoon, 1978; Wahrhaftig and others, 1994; Flores and others, 2004). For a detailed description of the tectonic setting for the Cook Inlet coal province, see Wahrhaftig and others (1994) and Flores and others (2004). Swenson (1997) suggested that the rock units are a laterally equivalent facies related to a dynamic nonmarine depositional basin. The coarsest facies, consisting of conglomerates and sandstones, were deposited in an alluvial fan system, which transported sediments from the uplifted Aleutian volcanic arc and accretionary complex margins (Flores and others, 2004). In the basin center, an axial-fluvial system reworked these alluvial fan deposits along with sediments that were transported into the basin from as far north as the present location of Fairbanks in central Alaska. Mires are interpreted as low lying and developed on meander belts deposited by laterally aggrading streams or anastomosing streams during vertical aggregation within the axial fluvial system (Flores and others, 2004). The Kenai Group is more than 25,000 ft (7,620 m) thick and all of the formations are coal bearing.

The Hemlock Conglomerate is unconformable in places and gradational and interfingering in others with the underlying West Foreland Formation (fig. 5). It consists mainly of pebble to boulder conglomerate units with a maximum thickness of about 2,772 ft (845 m). Coal and carbonaceous shale beds are sparse, vary from 2 inches to 2.5 ft (5 cm to 0.75 m) thick, and were interpreted to have accumulated in mires developed on abandoned flood plains and meander belts (Flores and others, 2004).

The Tyonek Formation consists of a sequence of sandstones, siltstones, mudstones, carbonaceous shales, and coal beds as much as 7,640 ft (2,330 m) thick (fig. 67; Calderwood and Fackler, 1972). The coal beds are generally lobe shaped and are interpreted as having been deposited in mires associated with alluvial-fan deltas (Flores and others, 2004). At

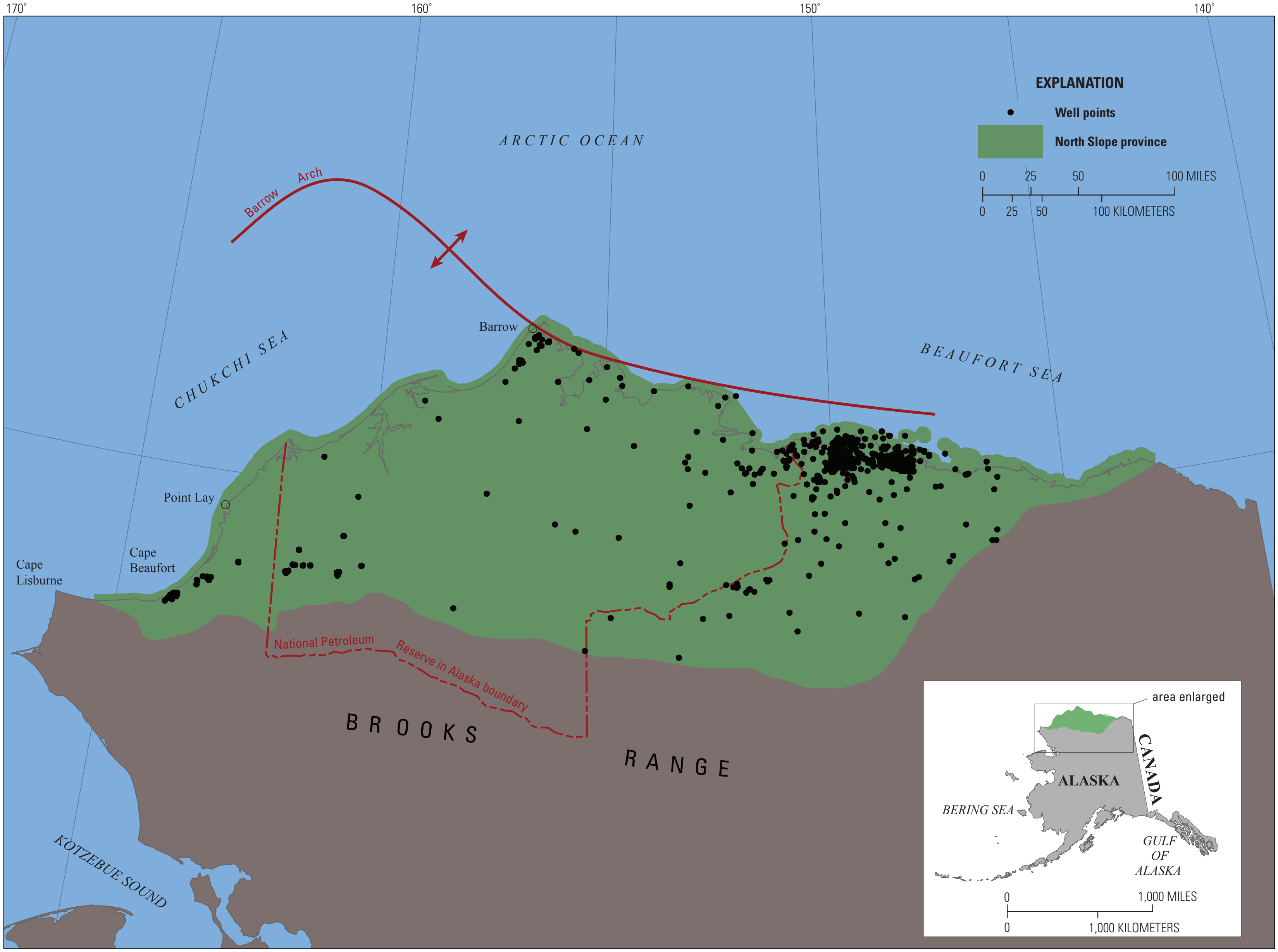

Figure 2. The North Slope province, coal data points, and location of chronostratigraphic column on figure 3.

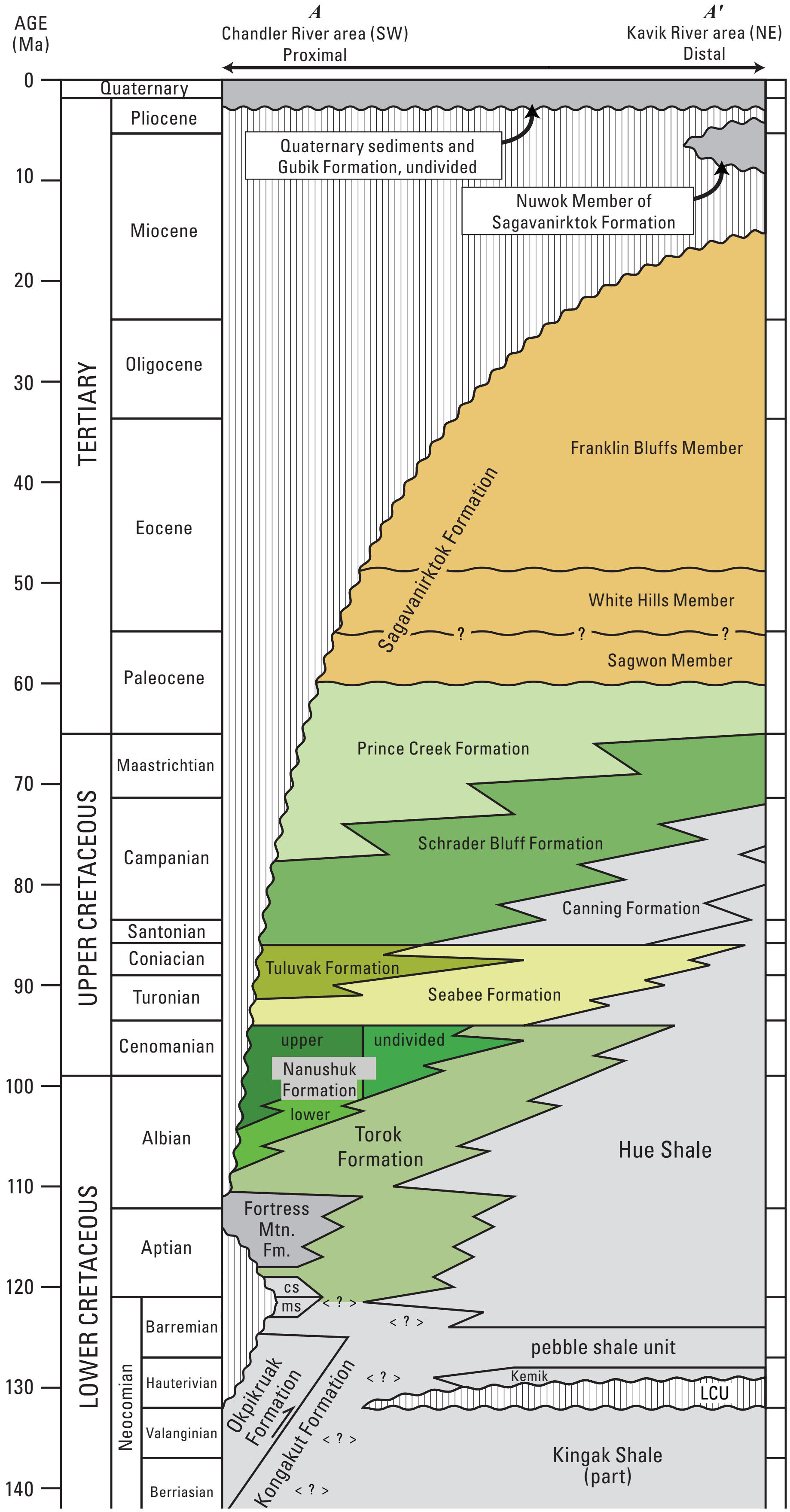

Figure 3. Chronostratigraphic column for the Colville Basin, northern Alaska. Abbreviations or symbols are as follows: <?>, uncertain relation; CS, cobblestone sandstone of Fortress Mountain Formation (informal unit of Mull and others, 2003); ms, manganiferous shale unit (informal term); Kemik, Kemik Sandstone (formation) as revised by Molenaar and others (1987); LCU, Lower Cretaceous unconformity. Geologic time scale from Gradstein and Ogg (1996). Modified from Mull and others (2003).

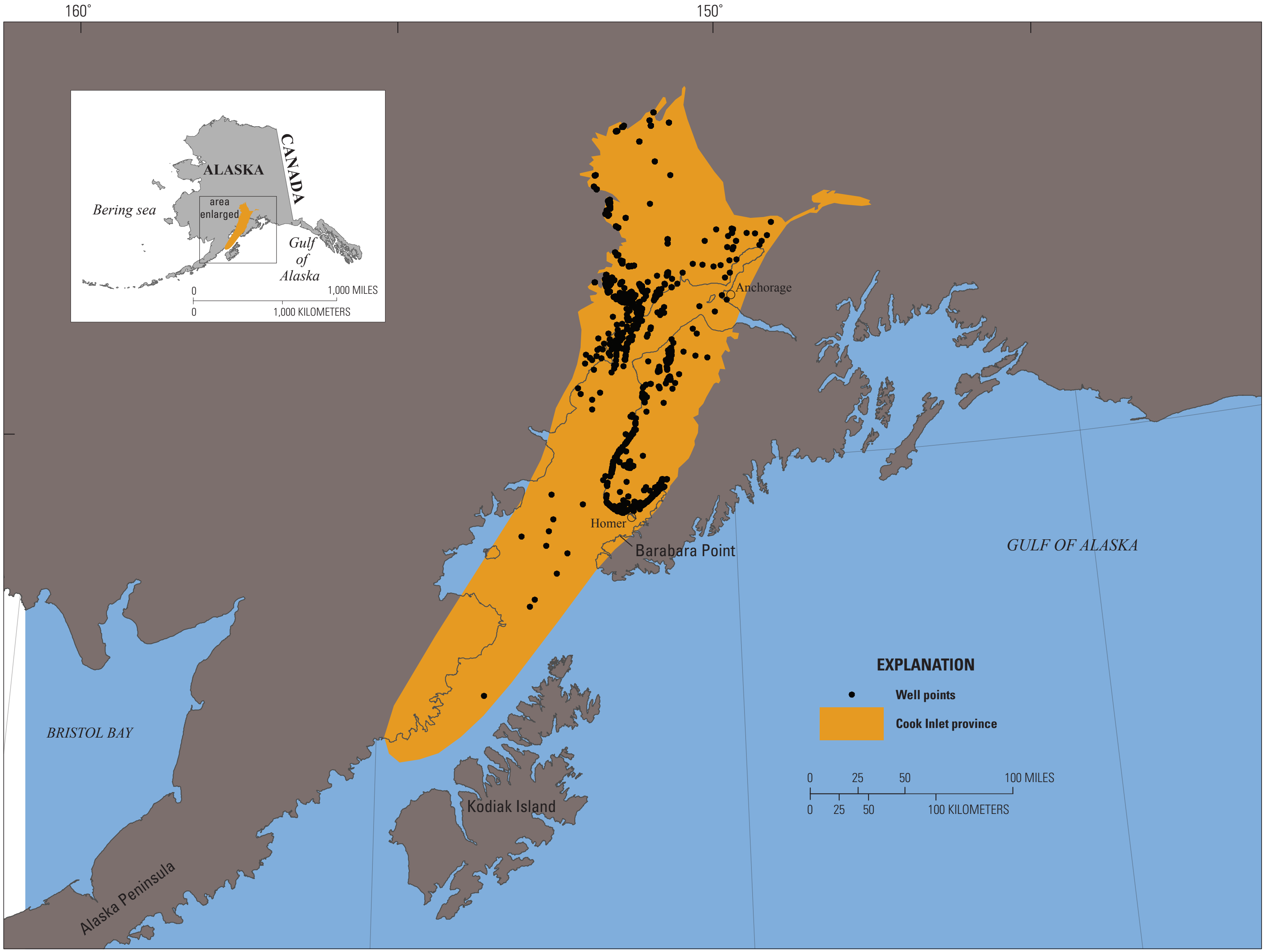

Figure 4. Cook Inlet province and coal data points.

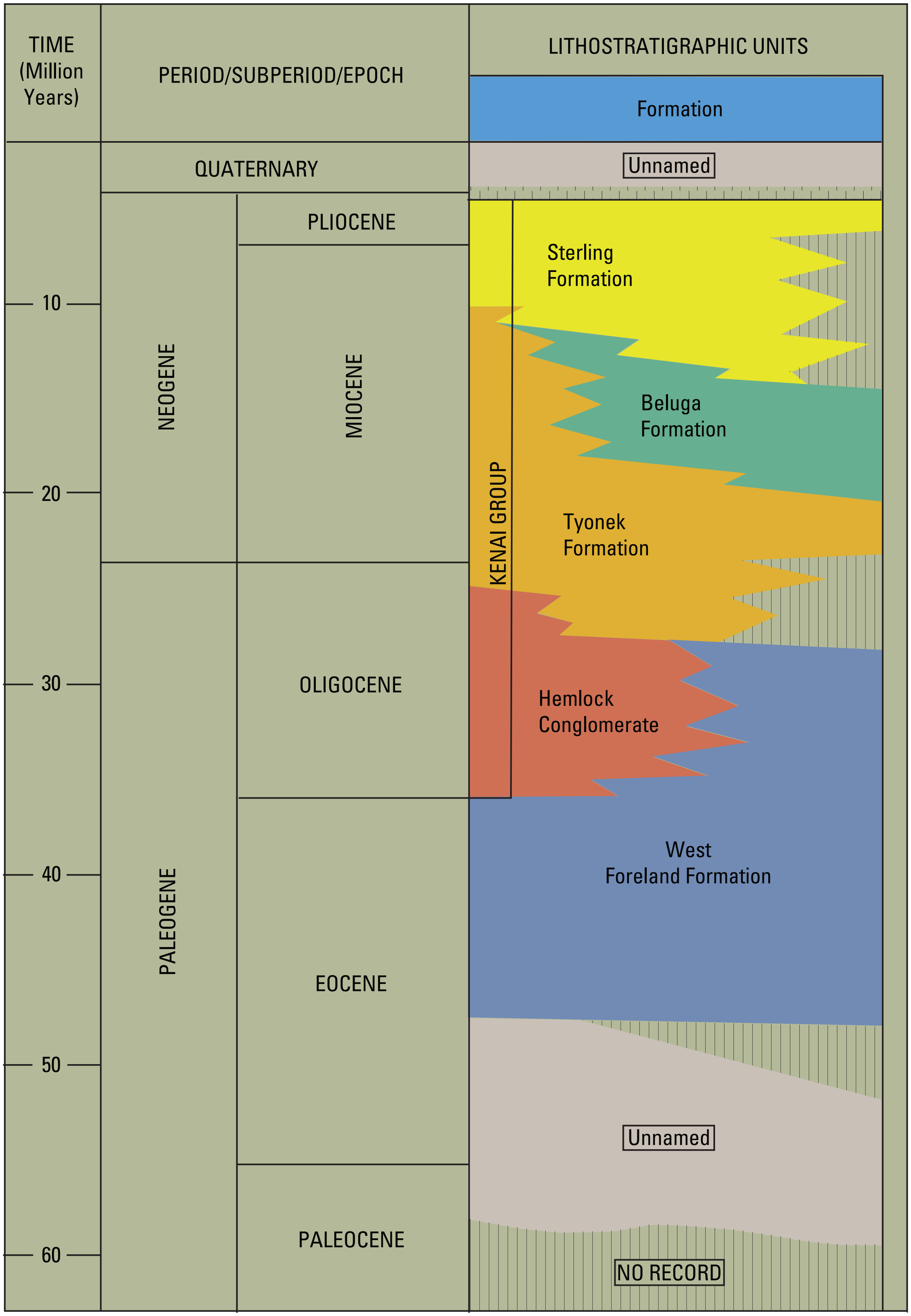

Figure 5. Generalized time-transgressive stratigraphy in the Tertiary Cook Inlet province. Modified from Flores and others, 2004 (as modified from McGowen and others, written commun., 1997 and referenced in Swenson, 1997).

those sites, abandoned alluvial-ridge braid belts of the fan deltas served as raised platforms where mires developed as much as 28 ft (8.5 m) of minable coal as described at the Diamond Chuitna coal-mine lease area by Flores and others (1994, 1997). The total coal isopach maps of Hartman and others (1971) and Hite (1976) show thinning to the northeast, southeast, and southwest toward the zone of minimum sandstone content. The southwest-northeast orientation of the net coal thickness isopach suggests that the coal accumulated in low-lying tidal sand flat and supratidal mires. Direct evidence of tidal influence in the Tyonek Formation by Stricker and Flores (1996) at Barabara Point, southwest of Kachemak Bay in the eastern Cook Inlet, was described. The tidal deposits overlie a sequence of conglomerate, sandstone, siltstone, and mudstone and contain coal beds that are a few inches to 2 ft (few centimeters to 0.6 m) thick.

The Beluga Formation, which is as much as 4,900 ft (1,500 m) thick, is composed of interbedded conglomerate, sandstone, siltstone, mudstone, carbonaceous shale, and coal (Calderwood and Fackler, 1972). Sandstones are the most abundant rock type and coal beds are the least common. Flores and Stricker (1993) suggested that the coal beds accumulated in mires on abandoned braid belts and anastomosed stream belts. Coal beds are numerous with individual beds as thick as 6.6 ft (2 m) (Barnes and Cobb, 1959).

The Sterling Formation is as much as 10,990 ft (3,350 m) thick and consists of sandstone, conglomeratic sandstone, siltstone, mudstone, carbonaceous shale, and coal (Kirschner and Lyon, 1973; Hayes and others, 1976; Hite, 1976; Hartman and others, 1971; Calderwood and Fackler, 1972). Coal beds are generally no more than 3 ft (1 m) thick, but a few are as thick as 8 ft (2.5 m) (Barnes and Cobb, 1959; Calderwood and Fackler, 1972).

Sources of Data

General sources of coal data included in this database are the Alaska Oil and Gas Conservation Commission, Alaska Department of Natural Resources, U.S. Geological Survey, Diamond Alaska Coal Company (now Pac Rim Coal, Inc.), U.S. Bureau of Mines, and U.S. Bureau of Land Management–Alaska. Another, more specific data source is listed in the "Metadata" section of the database.

Description of Data Tables

Data are reported in the following two tables; alaska_northslope.gbd for the North Slope coal province and alaska_cookinlet.gbd for the Cook Inlet coal province. Both tables contain the same number of data columns and the same column headings. Locations of data for drill holes are found in columns Wh_Lat (wellhead latitude in decimal degrees) and Wh_Long (wellhead longitude in decimal degrees); display of the data points in the ArcReader application is shown using Universal Transverse Mercator (UTM) projection, North American Datum of 1927. All elevations are in feet in relation to mean sea level datum. Thicknesses of rock units are in feet. For measured sections and outcrop data points, elevations are reported when they could be determined. In some cases, sections were measured along a stream course or along an ocean shore line; changes in elevation between units in the section are therefore nonexistent and could not be determined and. as such, are not reported.

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